U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE STATE OF INDIANA DEPARTMENT OF GEOLOGY; EDWARD BARRETT, STATE GEOLOGIST.

SOIL SURVEY OF LAKE COUNTY, INDIANA.

BY

T. M. BUSHNELL, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN CHARGE, AND WENDELL BARRETT, OF THE STATE OF INDIANA DEPARTMENT OF GEOLOGY.

W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1917.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., May 6, 1920.

SIR: In the extension of the soil survey in the State of Indiana during the field season of 1917 a survey was undertaken in Lake County. This work was done in cooperation with the State of Indiana Department of Geology.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1917, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. E. T. MEREDITH,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

FIGURE.

MAP.

SOIL SURVEY OF LAKE COUNTY, INDIANA.

By T. M. BUSHNELL, of the U. S. Department of Agriculture, In Charge, and WENDELL BARRETT, of the State of Indiana Department of Geology—Area Inspected by W. E. McLENDON.

DESCRIPTION OF THE AREA.

Lake County, Indiana, occupies the extreme northwestern corner of the State, adjoining the western State line and the suburbs of Chicago. It is bounded on the north by Lake Michigan and on the south by the Kankakee River. The county has an area of 314,880 acres, or 492 square miles.

Lake County comprises three main physiographic divisions, viz, the plain of glacial Lake Chicago, the Valparaiso morainic system and associated till plains, and the outwash plain and lake plain of the Kankakee Basin. The plain of glacial Lake Chicago, which adjoins Lake Michigan, extends south almost 9 miles along the eastern county boundary and 13½ miles along the western boundary. The Valparaiso morainic system comprises a belt 14 to 18 miles wide, extending in a general east-and-west direction across the county. The remaining and most southern portion of the county, a belt 4 to 8 miles wide, is included in the Kankakee Basin.

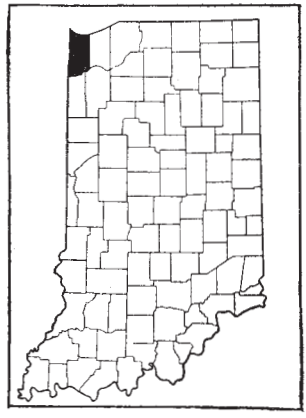


FIG. 1.—Sketch map showing location of the Lake County area, Indiana.

The plain of former glacial Lake Chicago is subdivided by ancient beach lines into distinct topographic steps, by which the land level rises from Lake Michigan to the elevation of the moraine. The northern and lowest terrace lies 10 to 24 feet above the level of Lake Michigan. West of Gary it is characterized by the presence of long, narrow, continuous, parallel ridges and sloughs, extending in the same general direction as the lake shore. East of Gary wind action has heaped the sand into irregular dunes, with peaks over 100 feet high. The middle terrace comprises a belt, over 2 miles wide, lying south of the 24-foot beach and north of the beach traversed by the Ridge Road, which is 48 feet above Lake Michigan. The Little Calumet River flows through this middle terrace at an elevation of about 20 feet above the lake. The southern and highest terrace extends from the Ridge Road to the 80-foot beach, which occurs along

or just north of the Lincoln Highway. Within this last terrace is a ridge, reaching west from Hobart beyond Hessville, which is an outlying portion of the moraine, and which formed an island when the beach stood at its highest level. South of the Ridge Road and north of Ross there was at one time a swampy tract known as "Cady Marsh."

The morainic belt is generally level enough for all farming operations, although it varies locally. The rugged northern slope developed in Porter County is lacking in Lake County, where the several members of the Valparaiso morainic system become more smooth and broad. There are three comparatively elevated and rough terminal moraines, separated by two areas of smoother ground moraine. The three ridges cross the county below Merrillville, near Crown Point, and near Lowell, in an east-and-west direction, but are broken by several glacial drainage channels or chains of depressions, which cut them at right angles. The roughest land in the county, except for the dunes, is found around these kettle holes. The general slope of the morainic belt is toward the south.

The Kankakee Basin comprises two distinct topographic belts—an outwash plain and a lake plain. The former borders the southern edge of the moraine, from which it is separated by only very slight changes of level. Its slope is southward, while the lake plain has a slight westward slope and its uniform level is broken only by a few wind-blown sand ridges.

Flat areas and numerous marshes are scattered over the county, and level areas of alluvial deposits occur along the streams. These bottom lands range from a few feet to over one-half mile in width.

Lake Michigan is 585 feet above sea level, while the higher portions of the moraine rise above 800 feet. Other elevations are: Tolleston, 609 feet; Calumet Beach (Ridge Road), 633 feet; Glenwood Beach (Lincoln Highway at Schererville), 655 feet; and the Kankakee River at the State line, 620 feet.

The divide between the Mississippi and St. Lawrence Basins crosses Lake County in a general east-and-west direction, but follows an extremely crooked line, passing through T. 34 N., R. 7 W., Leroy, the county fair grounds, Cedar Lake, and Saint John, and thence continuing west to the State line. The northern slope is drained by the Calumet River and its branches, and the southern by the Kankakee River system. Much of the land in both the lake plains and the depressions of the till country was originally marshy, and the present condition of good drainage has been effected by artificial means.

The Calumet River formerly flowed into Lake Michigan east of Miller Beach, but when a new outlet was cut for it in Illinois the former mouth was closed by sand bars, and the current of the Grand Calumet was reversed, so that it empties at Indiana Harbor. The main trib-

utary of the Calumet River in Lake County is Deep River, which through its dredged branches collects the drainage from Leroy to Saint John. This stream in post-glacial times has cut a valley 5 to 30 feet deep in the till and lacustrine deposits from a point near Grahams to its junction with the Calumet River. Eagle Creek, Spring Run, Cedar Creek, and West Creek, now dredged into deeper and straighter channels, occupy valleys which were cut by great currents of water during glacial times. Formerly they spread out on reaching the south edge of the upland and were lost in the broad Kankakee marshes, but a fairly adequate system of large dredged ditches now carries their waters nearly to Momence, Ill., before emptying into the Kankakee River. There are no streams or ditches emptying into the Kankakee in Lake County, and it drains directly only a small area lying south of the "dike," which has been constructed to protect the reclaimed marshes from overflow.

While the drainage conditions in Lake County have been revolutionized in the last 15 years, a number of places are still too wet for agricultural or other uses, as in the case of the sloughs west and northwest of Gary. Two important drainage projects have been proposed. One is the Burns Ditch, which is expected to divert the waters of Deep River and the Calumet River through a channel to be cut through the dunes in Porter County, thus reclaiming extensive marsh lands south of Gary. Another plan contemplates turning Eagle Creek directly into the Kankakee River near Beech Ridge, so as to relieve the Singleton Ditch of the run-off from 25,000 acres around Leroy. Large dredging operations are still in progress, straightening and deepening the channel of the Kankakee River. Deep River furnishes power for a small mill at Hobart, but the other mills of pioneer days have been abandoned.

The earliest settlers in this region came largely from more eastern settlements. A large number, however, came from foreign countries, principally Germany. Growth in population was only fairly rapid until the decade between 1890 and 1900, during which it increased by 58 per cent. The population increased 118 per cent from 1900 to 1910, and growth has proceeded at a rapid rate since that year. The total number of inhabitants in 1910 was 82,864. The rural population comprised 20.4 per cent of the total, and averaged 34.4 persons per square mile. Settlement is largely concentrated in less than 100 square miles in the northern part of the county, where the density averages over 600 persons per square mile. Native-born white persons constituted 63 per cent of the population in 1910, and foreign-born white persons 36 per cent. The persons of foreign or mixed parentage, mainly German, Austrian, Hungarian, Russian, Swedish, English, or Italian, form 31 per cent of the total population.

While all the cities of the county are steadily increasing in size, the growth of Gary has been most rapid, and it is estimated to have a population of more than 60,000 at present. The 1910 census reports the following population of other places: Hammond, 20,925; East Chicago, 19,098; Whiting, 6,587; Crown Point, 2,526; Hobart, 1,753; Lowell, 1,235; Miller, 638; Dyer, 545; and Griffith, 525.[1] Crown Point is the county seat.

Lake County is traversed by many railroads, all but one of which converge toward Chicago. Many of the lines have two or more main tracks, and run numerous trains for suburban traffic and milk collection. Especially in the north end of the county there are many large railroad yards, crossings, junctions, and shops closely bound together by belt lines on which an enormous tonnage of freight is handled.

In general the highways are adequate for present needs, but further development of the Kankakee Basin will create a need for more and better roads, and some of the dirt roads in the hill section of the county should be surfaced. No good gravel is found in Lake County, and very few roads have been made of that material. Limestone is commonly used, although a start has been made in the construction of concrete roads. A very close network of stone roads has been built in the northern third of the county. The heavy traffic of motor vehicles quickly puts the main traveled routes in poor condition. The Lincoln Highway and Jackson Highway traverse Lake County. Telephone service extends to all the rural districts.

Chicago has long been the principal market for the agricultural products of Lake County, especially milk, but the rapidly growing population in the other industrial districts is absorbing more and more of the output of milk, truck, poultry, and fresh-killed hogs and cattle. Sugar beets are sold to factories in Illinois and Michigan. Grain elevators at several points on the railroads handle most of the corn, oats, and wheat sold, while several small mills grind meal or flour for local use.

CLIMATE.

The climate of Lake County is to some extent influenced by the proximity of Lake Michigan. The winters are cold and the summers warm, with considerable ranges in temperature. The mean annual temperature as recorded at Hammond is 51°. The summer mean is about 71° and the winter mean about 25° F. Sudden changes in temperature often occur, and the monthly range may be as great as 80°. The highest temperature recorded is 105°, and the lowest −23°.

[1] Since this report was written the preliminary announcement of the population of Lake County and its civil divisions in 1920 has been issued by the Bureau of the Census, as follows: Lake County, 159,957; urban, 140,726; rural, 19,231; Crown Point, 3,232; Dyer, 479; East Chicago, 35,967; East Gary, 813; Gary 55,378; Hammond, 36,004; Hessville, 1,480; Highland, 542; Hobart, 2,375; Lowell, 1,197; Munster, 605 New Chicago, 300; Schererville, 483; Saint John, 279; Schneider, 258; Whiting, 10,145.

The annual rainfall averages about 31 inches. The heaviest precipitation occurs in the spring and summer, May being the wettest month. There is considerable variation in the monthly rainfall from year to year, with a direct effect upon crop yields. The snowfall averages 42 inches annually.

There is a normal growing season of 171 days. The average date of the last killing frost in the spring is April 27, and that of the first in the fall, October 15. The latest date of killing frost recorded in the spring is May 26, and the earliest recorded date in the fall, September 16. In 1917 killing frosts damaged the corn as far south as Rensselaer (Jasper County), about September 9, but soils, topography, local clouds, and air currents produced such variations that parts of fields were frozen and the remainder unhurt.

The following table giving the more important data is compiled from the records of the Weather Bureau station at Hammond:

Normal monthly, seasonal, and annual temperature and precipitation at Hammond.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	26.9	74	−15	2.20	1.51	3.97	7.9
January	23.7	67	−20	2.24	.55	1.07	10.4
February	23.8	63	−23	2.29	.71	1.83	13.8
Winter	24.8	74	−23	6.73	2.77	6.87	32.1
March	37.1	82	0	2.54	1.09	2.31	5.2
April	47.5	88	12	2.83	.13	4.60	.8
May	58.1	98	27	4.04	4.07	8.59	T.
Spring	47.6	98	0	9.41	5.29	15.50	6.0
June	68.2	102	34	3.10	1.36	9.93	0.0
July	73.1	105	39	2.77	3.15	2.21	0.0
August	71.5	102	43	2.25	1.07	.88	0.0
Summer	70.9	105	34	8.12	5.58	13.02	0.0
September	65.6	102	29	2.84	2.99	2.52	0.0
October	53.8	92	19	1.81	1.25	2.64	.1
November	39.2	77	1	2.31	2.50	2.80	2.4
Fall	52.9	102	1	6.96	6.74	7.96	2.5
Year	51.0	105	−23	31.22	20.38	43.35	40.6

AGRICULTURE.

The first white men in Lake County, after the explorers, were fur traders and trappers. Trapping and hunting continued to be important means of livelihood in the Kankakee marshes until they were

drained, some 20 years ago. The original land survey was made around 1831, about which time settlers drifted in from the East and located in favorable situations, where water and fuel were available. The first farms were self-sustaining, as the small fields of corn furnished home-ground meal, fish and game supplied meat, and flax was a source of homespun clothing. Sheep soon were brought in to yield wool to replace flax, and also as a source of mutton. The establishing of gristmills encouraged the growing of wheat.

Settlement was most rapid along the routes to Chicago, through the northern part of the county, and in the better agricultural land of the moraines, while the marsh lands of the north and of the Kankakee Basin were settled last. Large herds of cattle were grazed and thousands of acres of marsh hay were cut near the Kankakee River.

With the growth of Chicago and the building of railroads in the fifties, all the best arable land was put under cultivation except the marshes, the rougher forested areas, and the dunes, which have remained almost uninhabited to this day. The invention of improved machinery, such as binders, drills, and corn planters, stimulated grain production, and in 1879 about 74 per cent of the area of the county was in farms; this percentage has not greatly varied since. Dairying and the raising of live stock became important industries about 1900, and have continued to grow in importance.

The market demand of the great Chicago industrial district, of which the Calumet Basin is a part, has a dominant influence on the agriculture. Lake County is naturally divided into four distinct belts, in three of which a special form of farming predominates. These are the nonagricultural, the trucking, the dairying, and the grain or mixed farming districts. Poor soil, unfavorable topography, and the greater demand for industrial uses are reasons for the existence of the nonagricultural region, which extends from Hammond east along Tolleston Beach to Gary, where it drops south to include the Calumet marshes. The great trucking district is situated nearest the city markets, and comprises the sandy lacustrine soils north of Glenwood Beach, extending eastward nearly to Hobart. Dairying predominates in the region below the trucking districts as far as Crown Point, and is important along the transportation lines as far as Hebron (in Porter County) and Lowell. Strictly speaking, this region is one of mixed farming, with whole milk as the chief product sold. The southern end of Lake County is largely devoted to grain production, combined on some farms with breeding and the feeding of beef cattle. Trucking is just beginning on the dark sandy and mucky soils here, and may grow to large proportions. Cereals are by far the leading crop, although the interrelated products of hay, meat, and milk total a greater value. Poultry is a by-product on the average farm and usually represents a use of feed which would otherwise be wasted.

Notwithstanding the apparent development of special farm industries, corn growing is of greatest importance. The crop brings a large cash income; the grain is used to feed horses and fatten hogs and cattle; the fodder is used for wintering a large number of animals; corn silage is the basis of the dairy ration, and is also fed to fatten stock; and the shredded fodder is used for bedding and feed. Corn was grown on a total of 49,446 acres in 1909, and gave an average yield of 33 bushels per acre. Lake County leads the State in the number of silos in use.

Oats are commonly grown in alternation with corn as feed for horses and cows or for sale. The straw is used for roughage and bedding or for sale. The growing of oats aids in getting a hay crop on the land. Oats were grown on a total of 27,488 acres in 1909.

Wheat is a crop of uncertain yields, and the acreage fluctuates widely from year to year, depending on the success of the previous season. Wheat is grown principally in the Kankakee region, and as a source of income. It occupied a total of only 2,926 acres in 1909.

Irish potatoes are grown in most parts of the county for home use and sale, but most of the crop that is put on the market comes from the trucking district. There was a total of 2,347 acres devoted to potatoes in 1909.

Rye is a minor crop, grown chiefly for grain or for hog pasture. On poor soils it is often grown to provide green manure, to be plowed under. The census reports a total of 966 acres in rye in 1909.

The truckers produce large amounts of early vegetables, such as radishes, onions, and lettuce. They can not put their products on the market as early as the southern growers of truck, but proximity to splendid markets compensates for this disadvantage. The employment of women and children from the near-by foreign settlements of the industrial district helps to make truck growing possible. The farms are small, and the soil is heavily fertilized and worked intensively. In many cases several crops may be produced on the same land in one season. Vegetables, such as tomatoes, cucumbers, sugar beets, and cabbage, are usually grown under contract with canning, pickling, and sauer-kraut factories. Scarcely any stock is kept in the region where trucking predominates.

The existence of great natural pastures and hay meadows in the early days gave an impetus to stock raising, which, together with the needs of draft animals in the cities, created a steady demand for cultivated hays when the marshes were reclaimed. Some wild hay is still produced. Hay was cut from a total of 47,164 acres in 1909, of which 41,338 acres were in tame grasses and 5,826 acres in wild grasses. Timothy, the principal cultivated grass, is usually seeded on oat land and remains four to six years, furnishing not only hay, but also some pasturage each year. It is also a good cash crop

Timothy gives fair returns with a minimum outlay of money and labor, but it is generally recognized to be "hard on the land," and red clover is often seeded with it. When the latter succeeds, a crop of mixed hay is obtained the first cutting, and the soil is benefited by nitrogen fixed in the clover roots. The benefit to the soil from growing legumes and the high market price of the hay are leading to their gradual displacement of timothy. Several hundred acres of alfalfa are now successfully grown in small fields scattered over the county.

Production of whole milk is the prevailing specialized farm industry in Lake County, as the direct result of the demands of near-by city markets. The strictly dairy farm, where all the feed is bought, is almost unknown, and dairying is merely a more or less important part of the common system of mixed farming. Numerous steam and electric lines afford excellent transportation. The milk is delivered daily at the many loading platforms by individual farmers or by trucks which follow regular collection routes. There is an increasing tendency for the milk supply to be diverted from Chicago to the rapidly growing cities in northern Lake County.

This county has been called the "Denmark of Indiana." The predominant breed of dairy cattle is the Holstein, but there are small numbers of Guernsey, Jersey, Ayrshire, and Brown Swiss cows, as well as milk cows of the beef breeds. There were 12,774 dairy cows in Lake County in 1910. An active milk producers' association exists for the purpose of encouraging the raising of purebred stock, high-producing cows, testing, feeding, and marketing. At present (summer of 1917) the farmers receive 6½ cents per quart, while the consumer pays 13 cents, the difference being absorbed in transportation, pasteurization, and distribution. Producers report that under present conditions of large investment and high cost of feed and labor they really operate at a loss. The principal compensation is the manure, which increases the productiveness of the soils and is especially beneficial on the light-colored "clay" land, which is of wide distribution in the dairy section. Veal is a by-product of the dairy industry. All the bull calves and over half of the heifers (about 7,700 in a year) are marketed when about a month old, as it would not be profitable to fatten them.

The census of 1910 reports nearly 13,000 hogs kept on farms and about 11,000 sold during the preceding year. Hogs are quite generally distributed over the county, except in the industrial and trucking districts. They are handled in a variety of ways. They are usually pastured on rye, rape, bluegrass, clover, alfalfa, or similar crops. On many farms they follow fattening cattle, glean the ears knocked off by corn binders, or "hog down" corn, especially where the wind has flattened it. The animals are usually finished

on a ration of corn balanced by tankage, and marketed at the Chicago stockyards. Of late years local markets have absorbed more and more of the supply of fresh pork. Hogs are kept on every farm, but only a few farmers fatten them on a large scale or have more than a carload to sell at one time. There are breeders of purebred swine of the following types: Duroc-Jersey, Chester White, Poland-China, Berkshire, Hampshire, Mulefoot, and Yorkshire.

The census of 1910 reports about 9,000 head of mature cattle on farms, and about 3,500 sold or slaughtered the preceding year. Beef cattle are raised and fed in the central and southern portions of the county. More feeders are raised than are purchased outside the area. Some well-to-do farmers in the Kankakee Basin buy feeders in large numbers when the market is favorable. These may be pastured during the summer on wild meadows south of the Kankakee River, and returned to Lake County in the fall, to fatten on corn, corn ensilage, and cottonseed meal. Purebred sires are commonly used, and the stock is of high grade. A number of farmers have purebred herds of Shorthorn, Hereford, or Angus cattle. Much of the fattened stock is slaughtered for local markets.

About 7,000 sheep were reported on farms in 1909, and about 3,800 head were sold or slaughtered during that year. The most common type of sheep is the grade Shropshire. The usual practice in handling sheep is to bring in western feeders to clean up uncut grain, grasses, and weeds, and to market them after a short period of grain feeding.

Poultry raising is carried on as a side line. The fowls are usually mixed breeds and glean most of their sustenance from the barnyards or fields. The income from the sale of fowls and eggs reaches a large sum each year, in 1909 amounting to $123,132. There are several specialized poultry farms in Lake County, and a number of fanciers maintain pens of purebred birds, mainly white and barred Plymouth Rocks, single-comb Brown and White Leghorns, Rhode Island Reds, Bronze turkeys, and White Pekin ducks.

There are about 9,000 horses on farms in Lake County, besides the draft animals in the cities. The farm horses are mostly work stock of high grade, as purebred sires are commonly used. Breeders of Percheron, Clydesdale, French Draft, Belgian, and German Coach horses and Shetland ponies are established in Lake County.

The topographic variations from place to place influence the distribution of crops to some extent. The broad, level lands are usually devoted to large fields of cereals. Rougher areas, where the use of improved machinery is difficult, are generally used as pasture. The topographic disposition is of course the cause of poor drainage, which limits some areas to wild-hay production. Some recently reclaimed marshes are put in corn year after year.

Although corn, hay, and oats are grown indiscriminately on most of the soils, their proportionate acreage and yield vary with the different types. Better average yields are obtained on the dark-colored soils than on the typical light-colored land. Corn is damaged more by frost on low, mucky soils than on higher and more solid ground. The crop adaptation of different types of soil is usually well recognized, but market demands, the prevailing type of farming, and the scheme of rotation determine what crop shall be grown on each field. It is a fortunate coincidence that loose, sandy soils, suitable for trucking, are developed adjacent to the cities, and that much of the Miami silt loam happens to occur in the dairying belt, where its great need of nitrogen and organic matter is met by the large supply of manure from the stables. It is generally recognized that wheat is most likely to winterkill on "clay" lands, and that the best soils for that crop are the dark sandy types of the Kankakee Valley. Light-colored upland soils with heavy clay subsoils are considered too "cold" and wet for corn in rainy seasons. On the other hand, corn suffers from drought more quickly on types underlain by loose, sandy strata. Wherever the natural growth of plants indicates soil acidity, legumes will not succeed without special preparation.

Agriculture in Lake County is largely a system of mixed farming, which keeps the work well distributed the year round. Where oats are to be grown the stalk field is plowed or disked and harrowed, and the crop is drilled in about April 1, at the rate of 10 to 12 pecks of seed per acre. Some hay crop may then be sown on the same land. Part of the land for corn is plowed in the fall and part in the spring. The seed bed is disked, harrowed, and otherwise worked into good tilth. Planting begins about May 10. A bushel of seed covers 4 or 5 acres. On land free from weeds corn may be drilled in the row, but it is usually planted in check rows, so that more thorough cultivation can be given. Corn is kept free from weeds and cultivated three to five times, if weather conditions and other work do not interfere. The first cutting of alfalfa is made about June 1, followed by the harvesting of red clover, the second crop of alfalfa, wheat, timothy and oats, and the third cutting of alfalfa. Thrashing follows immediately, and much of the stubble ground is then broken. The seed corn is picked and the silos filled about October 1, and winter wheat is then sown. Corn is husked from the row, or cut and shocked. Shock corn is sometimes fed whole to cattle, or may be husked or shredded. Stover or shredded fodder is fed for roughage. Manure is spread on stubble fields after harvest, or whenever the farmer finds time for the work. Agricultural and stock shows, association and social-center meetings, short courses, and demonstrations of all kinds make demands on the farmers' time.

Farms in Lake County are unusually well equipped. Improved machinery, including binders, mowers, drills, corn planters, cultivators, hay forks, manure spreaders, thrashing and plowing outfits, and ensilage cutters are in common use. The farm buildings are excellent. Many dairy farms are models of convenience and sanitation. The farm dwellings are of a high average standard. Good roads, the use of automobiles, telephone service, rural delivery of mail, and well-maintained schools all help to make rural conditions attractive. The 1910 census reports the average valuation of farms in Lake County as $12,117 each. Of this amount, 74.1 per cent is represented by the land, 14.2 per cent by buildings, 2.6 per cent by implements, and 9.2 per cent by domestic animals.

It has been a common practice to alternate corn and oats on the same land for several years, after which it is seeded to timothy for four or five years. Other rotations comprise corn, oats, and clover, or corn, oats, wheat, and clover. On dairy and stock farms the rotations may be varied by using the land for pasture several years.

There is an unusually large supply of manure available from the dairy stables and the Chicago stockyards. This supplies in the best and cheapest form organic matter and nitrogen—the elements most needed in the light-colored soils. In 1909 only 298 farms reported the use of commercial fertilizers, at an average expenditure of $70 each. Potash is used on some of the mucky soils. Complete fertilizers are often drilled in with corn or wheat, at the rate of 100 to 200 pounds per acre, and they give fair average returns. Increased use is being made of phosphatic fertilizers, such as acid phosphate, bone meal, and rock phosphate, for corn, oats, and clover. There is much acid soil in the county, which has either been limed or is still in need of that treatment. Finely ground limestone is applied at the rate of 1 to 4 tons per acre. Limestone may be obtained in large quantities at about $1.25 a ton, including freight charges. In some cases air-slaked quicklime has been used, with good results.

About half of all the farms in Lake County used hired labor in 1909, at an average expenditure of $274.54. In 1917 good farm hands received $40 to $65 a month and board. Harvest wages ranged from $2 to $3 a day. Corn huskers are paid 5 to 6 cents a bushel. In harvesting, thrashing, and silo filling farmers make a practice of exchanging labor. Most of the farm laborers are native-born white persons and efficient workers. Foreign-born laborers are used in the trucking district.

The average size of Lake County farms remained about 140 acres for three decades, but dropped to 123.6 acres in 1910. This reduction in average size was probably due to increased numbers of 5 to 20 acre truck farms. About 71 per cent of the area of the county is included in farms, and 83 per cent of the farm land is classed as improved. In

1910 there were 233 farms of less than 20 acres, and 133 of over 500 acres, while 554 of the total of 1,814 farms contained between 100 and 175 acres.

The 1910 census reports 57 per cent of the farms as operated by owners, against 74 per cent in 1880. Forty-one per cent were handled by tenants, and 1.5 per cent by managers. When farms are rented under the share system the owner receives two-fifths to one-half of the crops. In some cases he pays for part of the seed and fertilizer, but seldom has an interest in the implements or stock. The tenant owns the implements and work stock, produces the crops, hauls them to market, and usually furnishes the labor for repairs about the farm. The owner reserves the right to decide what crops shall be grown, and it is generally specified that no roughage shall be removed from the farm. Sometimes the tenants pay a cash rental for the whole farm, or at least for the pasture land. There is a prevailing opinion that it is more profitable to rent a farm than to own one.

The average farm land in Lake County is valued between $100 and $200 an acre. The poorest land, in the northern part of the county, commands high prices because of its location near large industrial centers. Desirable truck land is sometimes held at $500 or more an acre.

SOILS.[1]

The soil material of Lake County to a great depth, in some places several hundred feet, consists of deposits laid down in the glacial period. Part of it is of ice-laid origin, having been formed under or in front of the great ice sheet, and left in relatively unmodified form, after it melted away, and the remainder is water laid, having been deposited in glacial lake beds or stream channels which have disappeared. The ice sheet advanced and receded several times and in a number of lobes, three of which have given rise to the present topography and soils of Lake County. These were (1) the Michigan lobe, approaching from the north through what is now the lake of that name; (2) the Huron-Erie lobe, coming from the northeast; and (3) the Saginaw lobe, wedging in between them, from Saginaw Bay. These three lobes were contemporaneous, and the waters melting from the ice along their southern faces assorted and spread an enormous amount of sand over the whole Kankakee Basin. In the early stages of this process the drainage water was doubtless held back by a limestone bar, near Momence, Ill., but the river channel

[1] Lake County adjoins Porter County on the east and Will County, Ill., on the west. Differences appear along the boundaries between Lake and Will Counties. This is due to changes in correlation resulting from a fuller knowledge of the soils of the region and the fact that the soils are now being mapped in much more detail than in the earlier work. The rolling phase of the Carrington silt loam as mapped in Will County is what is recognized in Lake County and other recent surveys as the typical Carrington silt loam, while the typical Carrington silt loam of Will County becomes the Brookston silt loam and the Carrington silt loam, mottled subsoil phase, of Lake County. Where differences appear in these maps, the names used in Lake County should be applied to the abutting soils in the earlier surveys.

cut through it, leaving marsh land instead of a lake. Wind action has formed a few sand ridges in this section.

The Michigan lobe, in its last advance, reached the northern edge of the Kankakee Basin. The melting water flowed out in blended streams or sheets in a southerly direction, forming a gently sloping outwash apron about 2 miles wide. The soil materials here were assorted and stratified by running water, and are consequently grouped with the terrace soils.

As the glacier moved down from the north it plowed up soils and bedrock of various kinds, and pulverized them into particles ranging from the finest clays to gravels, stones, and bowlders. These were transported by the ice. The material pushed ahead of it was finally deposited in long, irregular lines of hills and formed "terminal moraines." The material spread out under the ice sheet formed flatter areas called ground moraines. In Lake County most of the ice-laid material consisted of silt and clay with stones and bowlders distributed over the surface and through the soil. The rocks consist chiefly of granite, gneiss, fine-grained sandstone, and similar formations, with little limestone.

The present topography of central Lake County is almost the direct result of glaciation, little modified by erosion. The valleys of Eagle, Cedar, and West Creeks, and Spring Run were formed when great volumes of water came from the melting ice. Numerous irregular knolls and depressions, unconnected with surface drainage ways, were formed by ice action. Aside from minor differences in the parent material, drainage has been the main factor in the development of the different soil types derived from the original till, as it has determined the character of the vegetation and controlled aeration and oxidation of the subsoils.

During the retreat of the Michigan lobe a large lake was formed, which still exists, in a reduced size, as Lake Michigan. Three distinct beaches of the old lake cross Lake County in a general east and west direction. The oldest and highest, called Glenwood Beach, marks the northern edge of the ice-laid soils. It is about 80 feet above the present lake level. This beach passes through Dyer, north of Merrillville, and south of Hobart. It is shown by a sand ridge, which has been more or less eroded in many places.

For some reason the outlet of the glacial lake was rather suddenly deepened, so that its level dropped 32 feet. It stood at that point for some time, until its waves washed up the Calumet Beach, on which the Ridge Road is now located. Within the county between these highest beaches, there is a till-formed hill, which evidently comprised an island when the lake was first formed. Most of the lacustrine deposits of the same belt are so heavy that they must have been derived largely from the moraine and laid down in still water.

The lake level was again suddenly lowered, and the "Tolleston" Beach formed, 24 feet above the present elevation of Lake Michigan. Instead of flowing directly into the lake, somewhere in Porter County, the Calumet River was forced to flow west behind the beach until an outlet was obtained in Illinois.

Another subsidence brought the lake to its present condition, although its level seems to have remained stationary a while near the southern end of Wolf Lake and to have gone down more gradually over the area north of the Grand Calumet. In the northeast corner of Lake County, where the prevailing strong winds had better access to the beach, they have blown up high dunes, but otherwise the dominant factor in the formation of the glacial-lake soils, as in the case of those derived from glacial till, has been topography, which, in determining drainage, has influenced the growth of vegetation and the oxidation of the soil materials.

The following is the scheme of classification of the soils of Lake County into previously established series:

Classification of soils of Lake County.

Origin.	Color and vegetation.	Drainage.	Substratum.	Series.
Ice laid	Light-colored, forested	Good	Heavy	Miami.
	Dark-colored, prairie	Good		Carrington
		Fair		Brookston.
		Poor		Clyde.
Water laid	Light-colored, forested	Good	Heavy	Lucas.
		Good	Porous	Plainfield.
		Poor	Heavy	Homer.
		Poor	Porous	Calumet.
	Dark-colored, prairie	Good	Porous	Waukesha.
		Fair		Newton.
		Poor		Maumee.
Recent alluvial	Brown, often forested			Griffin.
	Black, usually prairie			Wabash.

The Miami series embraces the well-drained, forested areas, having light grayish brown surface soils and yellow or yellowish-brown subsoils. The latter show little or no mottling, and rest upon unweathered calcareous material at a depth of 2½ to 3 feet.

The surface soils of the Carrington series are dark brown, and the subsoils are brown to yellowish brown, resting upon unweathered, moderately calcareous till at a depth of 2½ to 3 feet. These soils have an undulating to rolling topography and are naturally well drained. They are derived from ice-laid deposits which have existed under prairie conditions, and large quantities of organic matter have accumulated in the soil.

The Brookston series differs from the Carrington in its poorer average drainage, which is associated with a flatter topography and characterized by an impervious, grayish lower subsoil, mottled with yellow and brown.

The soils of the Clyde series are black or very dark gray to an average depth of 14 inches. The subsoil is mottled gray, drab, yellow, and brown, with gray as the dominant color. These soils are developed in depressions in the areas of till, where marshy conditions have favored the accumulation of organic matter and where the soil material has been washed in from adjacent lands. The lower subsoil may be moderately calcareous, and the substratum is calcareous till.

The Lucas series resembles the Plainfield in the yellow color of soil and subsoil, but differs in having a heavy clay substratum, which prevents the soil from being droughty. Faint gray mottlings occur in the subsoil.

The members of the Plainfield series are derived from water-laid materials. They have light grayish brown soils with light yellowish brown subsoils and a sandy substratum, which affords good to excessive underdrainage.

The Homer series includes lacustrine soils having a grayish surface soil, a white or mottled subsurface layer, and light-gray and yellow, compact clay subsoil. The topography is rather flat.

The Calumet series is characterized by light-brown to brown, shallow surface soils, with a pale-yellowish or brownish subsurface layer of varying thickness. The subsoil has undergone the degree of oxidation characteristic of lake-bottom or beach material, and consists chiefly of colorless, pure quartz grains and a small amount of sand and gravel from darker colored rocks. The Calumet series is related to the Plainfield, but is derived from more poorly drained and geologically younger deposits. The older, higher areas are forested with scrubby oak, while the lowest and youngest areas bear a growth of poplar, brush, and coarse grass, with willow along the marshes.

The Waukesha series is characterized by dark-brown or black surface soils extending to a depth of 10 or 15 inches, and underlain by a brown or yellowish-brown subsoil which rests, at a depth of 2 or 3 feet, upon a porous substratum consisting of stratified beds of sand or gravel.

The surface soils of the Newton series are dark brown. The subsoils are yellowish brown, more or less mottled with gray, and underlain by grayish, stratified material varying from sandy to heavy, according to the texture of the particular type.

The Maumee series is characterized by a black soil and a gray subsoil which, with depth, becomes slightly mottled with brown and yellow, or stained with bog iron ore. The substratum consists of stratified material which may be moderately calcareous.

The Griffin series includes areas of recent alluvium along streams where the soil is brown and the subsoil is brown mottled with drab and gray.

The Wabash series includes the recent-alluvial areas where the soil is deep and black, underlain by a mottled gray and brown subsoil.

Muck and Peat represent areas of cumulose deposits, consisting of vegetable matter in varying stages of decomposition. Where the material consists almost entirely of organic matter it is mapped as Peat, while areas in which considerable mineral matter has become incorporated with the plant remains are shown as Muck.

The type mapped as Swamp includes the wet, poorly drained, forested strip along the Kankakee River, where agriculture now can not be carried on.

The areas of sand dunes, largely uninhabited and practically non-agricultural, are mapped as Dunesand.

In the following table are shown the name and the actual and relative extent of each type mapped in Lake County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami silt loam	36,736		Newton loamy fine sand	5,376	1.7
Hilly phase	7,744	15.3	Waukesha loam	4,544	1.4
Dark phase	3,328		Swamp	4,544	1.4
Carrington silt loam	10,432	12.4	Clyde silt loam	3,840	1.2
Mottled-subsoil phase	28,544		Lucas fine sandy loam	3,136	1.0
Brookston silt loam	34,752	11.0	Newton loam	3,072	1.0
Plainfield fine sand	18,944	9.7	Homer silt loam	1,984	.9
Rolling phase	11,712		Better-drained phase	832	
Muck	27,584	9.0	Wabash silt loam	2,240	.7
Shallow phase	704		Waukesha fine sandy loam	2,240	.7
Maumee silty clay loam	19,648	6.2	Miami fine sandy loam	2,176	.7
Maumee fine sandy loam	12,800	6.2	Dunesand	1,856	.6
Mucky phase	6,464		Carrington loam	1,856	.6
Maumee loamy fine sand	11,392	3.6	Plainfield fine sandy loam	1,728	.5
Calumet fine sand	11,072	3.5	Griffin fine sandy loam	1,152	.4
Newton fine sandy loam	8,960	2.8	Peat	768	.2
Newton silt loam	1,792	2.6	Plainfield loamy sand	448	.1
Heavy-subsoil phase	6,336		Pits	64	.1
Clyde silty clay loam	7,232	2.3			
Maumee loam	6,848	2.2	Total	314,880	

MIAMI FINE SANDY LOAM.

The soil of the Miami fine sandy loam consists of light grayish brown loamy fine sand to fine sandy loam to a depth of about 7 inches, where it becomes light yellowish brown in color. At about 12 inches the material ranges from a compact fine sandy loam to a loam or sandy clay loam. The lower subsoil and substratum grade into moderately heavy till. Gravel and bowlders are scattered over

the surface or imbedded in the soil. It is probable that the sandy nature of the surface soil is due to glacial currents or to erosion and wind action of more recent times.

The largest area of Miami fine sandy loam is found near Ainsworth. Others are situated near Fatout and along the main drainage ways of the glacial belt. The topography ranges from fairly level to rolling or broken along stream valleys. Surface drainage is good, and some of the land is subject to erosion.

The smoother areas of this soil are cultivated, while the rougher portions are in pasture or forested. Corn, oats, and hay are the leading crops grown. Some farmers consider this soil better for corn in wet seasons than the Miami silt loam, and they report that wheat on this sandy land will survive a winter which kills it out on the "clay" lands. The type withstands drought well when carefully tilled. Average yields are about 30 bushels of corn, 35 bushels of oats, or 1 ton of hay per acre.

Corn, hay, and oats are grown to furnish feed for dairy and work stock, while the excess grain and hay is sold. The cropping system usually is designed to protect the soil from washing. Manure is the chief fertilizer, although some phosphate is used. Well-improved land of this type is held for $90 to $100 an acre.

The greatest needs of this type are more organic matter and the incorporation of nitrogen and phosphoric acid. The first two constituents are generally supplied by using the manure produced on dairy farms, but they can also be obtained from growing and plowing under legumes. In order to grow clover or alfalfa liming and inoculation of the soil are necessary.

MIAMI SILT LOAM.

As typically developed, the Miami silt loam is a light grayish yellow or brownish-gray, smooth, friable silt loam to an average depth of 10 or 12 inches. This is underlain by light yellowish brown or buff silt loam to silty clay loam, which is slightly friable, but becomes somewhat plastic at about 22 inches. The lower subsoil is a moderately plastic and compact silty clay loam or clay, becoming heavier and more brittle with depth. It is yellowish brown, sometimes faintly mottled with yellow and gray. Lime can not be detected by acid tests within 2½ or 3 feet of the surface, but it is usually found in the substratum, which is a heavy till extending to a considerable depth. Some bowlders and small stones are found on the surface and in the soil section.

Variations occur in the areas of Miami silt loam as mapped, owing to the inclusion of small patches of soils of other types. Slight textural variations occur where the type is associated with sandy soils. In a virgin state it has a dark-gray surface layer, 1 to 3 inches thick,

due to leaf mold or perhaps to grass roots. The surface of plowed fields when wet appears dark, and when dry very light. The subsoil, especially in the northern part of the county, seems to be heavier and more compact and mottled than in previous surveys.

The Miami silt loam is the predominant type in the three strips of timberland extending from Ainsworth to Leroy, from Crown Point to Lowell, and from Schererville to the Kankakee Basin. Other areas are found near Hobart, Belshaw, Cedar Lake, and Hebron in Porter County. The type has a gently undulating to gently rolling surface, well suited to cultural operations. The natural run-off is fair to good. In many places it has been artificially improved. The underdrainage is poor, owing to the compact nature of the substratum. Tile drains are not in common use, as they do not drain this compact soil far from the line of the tile.

This is one of the more extensive and important types of the county. Probably 90 per cent of it is under cultivation, and some of it has been cultivated more than 80 years. It originally supported a heavy growth of white oak, black oak, red oak, hickory, walnut, and other trees. The principal crops grown are corn, oats, hay, and some wheat. Dairying is engaged in by most farmers. Although whole milk brings in considerable revenue, many dairymen consider that the profit lies mainly in the fertility returned to the land in the manure. Hogs are kept on nearly every farm, and beef cattle take the place of dairy cows on some farms where the location or the preference of the owner is against dairying. Rye, potatoes, barley, and buckwheat are crops of minor importance. Ordinary yields are 30 to 50 bushels of corn, 35 to 70 bushels of oats, 20 bushels of wheat, and 1½ tons of hay per acre. Corn is likely to suffer in wet seasons, and wheat tends to kill out in severe winters.

Farming on this type is usually designed to build up the productiveness of the soil and to keep it in good physical condition. The rotations usually include corn, oats, and hay, and may be varied with wheat and clover. Part of the corn crop is put into the silo, as ensilage is fed to stock on nearly every farm.

This soil is primarily in need of organic matter and nitrogen, which are supplied in the unusually large amount of manure available. Manure spreaders are in constant use. Relatively small amounts of commercial fertilizers are used. Phosphatic or "complete" fertilizers are preferred, and are applied at the rate of about 150 pounds per acre with corn or oats.

The average value of farms consisting largely of Miami silt loam is about $125 an acre. Well-improved farms are held for higher prices, and some of the land could be bought for less.

This soil is generally acid, and very acid in some places, which are indicated by the growth of red sorrel and briers. Liming and the

use of acid phosphate would be very beneficial. Surface and tile drains should be extended.

Miami silt loam, hilly phase.—The hilly phase of the Miami silt loam is almost identical with the typical soil in the 3-foot profile and substratum. Some bowlders and gravel occur on the surface and through the 3-foot section. Some of the small areas near Fatout and in other sections of the county really represent Miami loam, having a slightly sandier soil and subsoil than the silt loam.

The principal areas of this phase are mapped between Crown Point and Cedar Lake, southeast of Crown Point, and along the valleys of West and Cedar Creeks. It is of small extent. The topography ranges from quite steeply rolling to rough and hilly. The broken land is developed in depressed areas below, rather than on hills above, the general elevations. Only small areas are suitable for cultivation. The run-off is good or excessive, but erosion is slight because of the coherent nature of the soil and the protection afforded by grasses and trees. Corn, oats, and timothy are grown on the smoother areas, but the yields are low. Part of the phase is in forest and part in pasture. It is adapted to use for permanent pasturage or for hay production. The land is valued at about $75 an acre.

Miami silt loam, dark phase.—The Miami silt loam, dark phase, consists of a gray to dark-gray, friable silt loam, 4 to 6 inches deep, passing into yellowish-gray silt loam. The subsoil is a yellow clay loam to silty clay, becoming quite compact and impervious and more or less mottled with gray and brown. A variation included with this phase in mapping has a lighter yellowish gray surface soil and a mottled subsoil somewhat like that of the Crosby soils, though it lacks the definite, whitish subsurface layer of that series.

This phase is found in small areas east of Crown Point and elsewhere over the central morainic belt along the contact between the forested and prairie land. The topography is quite flat or very gently undulating. Drainage is naturally poor, as the rainfall does not run off rapidly, and the impervious nature of the subsoil prevents its downward percolation. This soil formerly supported a sparse growth of forest and an undergrowth of hazel bushes, and was called "hazel-brush land." Old settlers state that some existing groves of trees have grown up on the prairie since the pioneer days. This would explain the unusually dark surface soil, such as is generally confined to prairie areas.

Most of the phase is now used for growing corn, oats, and timothy, or for pasture. In average yields of the principal crops and in selling value it compares favorably with the typical Miami silt loam. Its principal need is better drainage.

CARRINGTON LOAM.

The Carrington loam to a depth of about 10 inches is a dark-brown loam. This is underlain by brown loam which grades into yellowish-brown or buff silty clay loam to silty clay at depths of 12 to 18 inches. The substratum is a friable, moderately calcareous till.

This soil occurs in a number of small areas scattered over the morainic belt. It is found on slopes and knolls along the contact between till and outwash material, and may be of mixed origin.

Both surface run-off and underdrainage are naturally well established.

Corn, hay, and oats are the principal crops on this soil. Some fields are used for pasture. Yields are approximately equal to those obtained on the Carrington silt loam. This soil is considered slightly easier to cultivate than the silt loam, but the methods of handling and the farm values are about the same.

CARRINGTON SILT LOAM.

The Carrington silt loam consists of dark-brown to black, friable silt loam, about 12 inches deep, underlain by brown to yellowish-brown silty clay loam to silty clay. The substratum usually consists of heavy, slightly calcareous till. Bowlders, stones, and gravel occur on the surface and in the soil. Small included areas of other soils give rise to some variation in the type as mapped.

This soil is mapped in large areas near Merrillville, Creston, and Brunswick, and along the southern border of the till belt. It has a gently undulating to gently rolling surface, with long, smooth slopes and irregular knolls. As mapped in Lake County it includes the more uneven portions of the prairie areas, where the subsoil is well oxidized to a depth of 3 feet or more. The till is rather heavy and in the smoother areas the type grades into the mottled-subsoil phase.

The Carrington silt loam has good drainage, owing in part to the slope to depressions and stream ways, and in part to the system of open ditches and tile drains. The structure of the soil and subsoil is open enough to permit of adequate underdrainage and oxidation of the material to a depth of several feet.

This is one of the most important soils, agriculturally, in Lake County, as it is fairly extensive and contains no waste land. It was originally prairie. The soil is well suited to general farming, and is used for growing corn, oats, and hay, and for the production of beef, pork, and dairy products. From 35 to 40 bushels of corn or oats per acre is considered a fair yield, but in some cases this is doubled. Average yields of 1¼ tons of timothy or mixed timothy and clover hay are obtained.

The type is handled largely under the common "corn-belt" system of farming. Corn, the main crop, is largely fed to horses, cattle, and hogs, the excess being sold. The shredded cornstalks are used for winter roughage. Part of the crop is put into the silo. In favorable locations dairying is carried on. With the exception of barn-yard manure, very little fertilizer is used on this soil.

The greater part of this type is valued at $125 to $200 an acre.

Although this soil is naturally rich in organic matter, long continued cropping has in most places greatly depleted the supply, and green vegetation and animal manure should be plowed under.

Carrington silt loam, mottled-subsoil phase.—The Carrington silt loam, mottled-subsoil phase, is a dark-brown to black, friable silt loam to an average depth of 10 inches. The subsoil is a moderately friable, yellowish-brown silty clay loam, becoming at about 20 inches a compact, yellowish-brown silty clay, which is mottled, speckled, or streaked with light gray and brown. Below a depth of 30 inches very little weathering has taken place, and the till or parent material is friable and moderately to highly calcareous. The variations within this phase are due chiefly to small included areas of typical Carrington silt loam, Carrington loam, and Brookston silt loam, the boundaries between these soils being rather indefinite.

This phase is mapped throughout the morainic belt, but chiefly in the large prairies south of the latitude of Crown Point. Its topography is typically undulating, and well adapted to the use of improved farm machinery and extensive cultural operations. It also insures excellent surface drainage, although the relative imperviousness of the subsoil hinders underdrainage and aeration, as is indicated by the mottled color.

This is one of the most extensive and important soils in the county. It is strong, productive, and well improved. A well-balanced system of farming is usually carried on, including the growing of corn, oats, and hay, and the handling of live stock—principally beef cattle, hogs, and dairy cows. This is naturally a prairie soil, but trees have been planted around most of the farmhouses for windbreaks.

Corn averages about 40 bushels, oats 45 bushels, and hay 1½ tons per acre. On the best fields and in favorable seasons these figures may be doubled. The last three or four seasons have been very well suited to oats, which have often yielded 70 to 90 bushels per acre.

Farms on this soil have modern equipment, and operations are conducted on a rather extensive scale. Manure is returned to the fields by means of spreaders. The soil is generally neutral or only slightly acid, and liming is not necessary for general farm crops except the legumes. Phosphoric acid causes decided increase in

crop yields. It is profitably applied in the available form of "acid phosphate."

An average valuation of farms on this phase is about $145 an acre, but some farms near towns, on stone roads, with good buildings and fences, are valued above $200 an acre. The extremely high values are clearly not based on the net earning power of the farm.

This soil should be handled with a view to maintaining the content of organic matter and increasing the supply of phosphoric acid. Tile drainage would benefit many fields.

BROOKSTON SILT LOAM.

The Brookston silt loam consists of 10 or 12 inches of very dark brown to black, friable silt loam, underlain by gray silty clay loam, mottled with yellow and brown, passing into compact silty clay, which may become brownish in the lower depths. Variations occur in which the soil may be deeper than typical, or where it may be a silty clay loam, closely resembling the Clyde silty clay loam. Elsewhere the type may be almost indistinguishable from the mottled-subsoil phase of the Carrington silt loam. In fact, the degree of drainage is the chief cause of difference between the silt loams of the Clyde, Brookston, and Carrington series. The substratum is a friable, moderately calcareous till, like that which underlies the Carrington silt loam.

The Brookston silt loam is the predominant prairie soil on the ground moraine north of the latitude of Cedar Lake. The topography is gently undulating to level, the type often lying in saucer-like areas. Drainage is somewhat imperfect, being intermediate between that of the Clyde and Carrington soils. Often an impervious subsoil has caused the development of a grayish subsoil even where the surface slope is good.

This soil is relatively extensive, and owing to its high productiveness it is widely used in mixed farming. The usual grain crops are grown, and dairying or other stock farming is generally engaged in. The type probably produces as large crops as any soil in the county. Average yields of over 40 bushels of corn, 1½ tons of timothy, and 45 bushels of oats per acre are generally expected, although seasonal fluctuations are great. One acre of corn will make 8 or 10 tons of ensilage.

Most of this type is well located, and it has an average selling value of $150 an acre.

Parts of the Brookston silt loam are in need of tile drainage, and the type generally is in need of phosphatic fertilizer to keep crop yields up to the maximum. Fertilizers other than manure and acid phosphate are seldom used. Clover or alfalfa should be grown instead of timothy, both for their greater value as stock feed and as a market crop, and for the benefit to the soil.

CLYDE SILT LOAM.

The Clyde silt loam consists of a black silt loam, about 10 to 20 inches deep, underlain by light-gray, plastic silty clay, slightly mottled with brown or yellow. Some areas have a rather loamy or mucky surface soil. In places the subsoil below 30 inches may be slightly calcareous, and in all areas the substratum is calcareous till, only slightly weathered.

This type occurs in a number of small areas scattered over the morainic belt in shallow swales, as well as some distinct kettle holes. The topography is quite level and usually distinctly depressed below the surrounding soils. The areas were formerly intermittent marshes or ponds, but are now largely drained by surface ditches or tile.

Owing to its relatively small extent the Clyde silt loam is unimportant, although when well drained it is highly productive. It is used for the ordinary staple crops. Corn yields average about 40 bushels per acre, and other crops yield proportionately well. Corn is often planted several years in succession.

CLYDE SILTY CLAY LOAM.

The soil of the Clyde silty clay loam is a black silty clay loam to silty clay, 12 to 20 inches deep. The subsoil is a light-gray or drab, heavy, plastic silty clay, mottled with yellow and brown below 24 inches. In places gray predominates in the lower subsoil and yellow in the upper part. The substratum consists of moderately calcareous till. Some stones are found on areas of this soil.

The Clyde silty clay loam is derived from till occurring in depressed, wet situations. The surface material may consist partly of wash from the adjoining land, and it is difficult to decide in some cases whether the soil should be classed with the Clyde or Maumee series, both of which are depressed and poorly drained soils.

The Clyde silty clay loam generally occurs in relatively small but distinct areas scattered over the upland portion of the county. Originally it supported a growth of marsh grasses, although areas associated with the Miami soils sometimes were covered with water maple, elm, ash, beech, willow, and other trees.

The surface is low and flat, although the edges of areas often slope upward toward the borders of the adjacent soils. Drainage was originally very poor, and ponds were formed in wet seasons, but the areas often lie in such positions and at such elevations that a surface ditch or line of tile effectually drains a chain of them.

This type is mapped in numerous small areas, but is not extensive. As the drainage is improved these areas, formerly used only for hay production or pasture, are farmed more extensively to cultivated crops, such as corn, hay, and oats. Clover is sometimes grown, and some areas still support a growth of the native grasses.

Timothy yields about 1½ tons per acre. Where the land is well drained, and in favorable seasons, corn yields over 40 bushels per acre and oats even more. Corn is often damaged by early frosts, but gives unusually good yields of ensilage.

The selling price of this land depends largely upon the value of the surrounding soils. Well-improved and well-located farms bring $125 to $175 an acre.

The chief need of this land is better drainage. It is new and naturally productive, and fertilizers are not needed or used to any extent.

LUCAS FINE SANDY LOAM.

The Lucas fine sandy loam consists of grayish-brown fine sandy loam, about 8 inches deep, underlain by yellowish-brown fine sandy loam to fine sandy clay loam, more or less mottled with gray. Near draws or streams the subsoil lacks the typical mottlings, while on flats, where the drainage is not effective, it is heavily mottled like the Homer soils.

This soil is found only in the vicinity of Hobart, where heavy lake sediments are veneered with sands. The topography is quite flat except for eroded spots near Deep River and its branches. The surface drainage has by artificial means been made fairly adequate, but the impervious subsoil checks the downward movement of moisture.

The total area of the Lucas fine sandy loam is small, but it is located in a region of dense population and is all in use. The farming operations are quite diversified, and the products include cereals, milk, and truck. Corn and oats yield 30 to 40 bushels per acre in average years, and timothy about 1½ tons of hay. The type has a high selling value.

Below are given the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Lucas fine sandy loam:

Mechanical analyses of Lucas fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
282758	Soil	0.0	1.9	8.6	53.8	5.6	25.7	4.2
282759	Subsoil	.2	1.9	7.2	52.1	6.5	25.9	6.0
282760	Lower subsoil	.1	1.8	6.4	27.9	6.9	36.8	20.2

PLAINFIELD LOAMY SAND.

The Plainfield loamy sand consists of a brown loamy sand, 6 or 8 inches deep, underlain by yellowish-brown material ranging from loamy sand to coarse loamy sand or gravelly loamy sand.

This soil is mapped in two areas—one at Ross and one at Blackoak. They constitute the only mappable areas of Plainfield soils coarser than fine sand to be found in Lake, Porter, Starke, or White Counties.

The areas consist of long, flattish ridges elevated slightly above the contiguous soils. The drainage, both surface and underground, is excessive.

This soil was originally forested with scrubby oak. At present about 80 per cent of it is under cultivation. Corn, oats, timothy, cucumbers, tomatoes, melons, potatoes, and orchard fruits are grown. In crop yields and selling value the type corresponds to the Plainfield fine sand.

Several pits are found in the areas of Plainfield loamy sand from which a sandy grade of gravel was at one time taken.

PLAINFIELD FINE SAND.

The Plainfield fine sand consists of grayish-brown loamy fine sand, 6 or 8 inches deep, underlain by light yellowish brown loamy fine sand to loose fine sand, which usually extends to a considerable depth without change. In forested areas the surface 2 or 3 inches is quite dark in color, owing to leaf mold, while immediately beneath this a light yellowish brown color is developed. Under cultivation the soil is rather light in color.

Areas of Plainfield fine sand are encountered in the Kankakee Basin and in the Lake Chicago plain as far north as Hammond. The topography in general ranges from flat and smooth to slightly ridged or billowy. West of Tolleston the type occupies long, low, narrow ridges.

On account of its comparatively elevated position above the water table and the loose character of the material, this type is droughty, and the droughty tendency has been increased by the extensive drainage operations, which have lowered the water table. The greater part of the rainfall is absorbed by the soil.

This was formerly the only arable soil in some localities, but its relative importance decreased when adjacent marsh land was reclaimed. Possibly 40 per cent of it is still forested with small red oak, black oak, pin oak, and some hickory. The tree growth in the northern areas, around Hammond and Gary, is not so thrifty as that around Hobart, where there is often a heavy substratum, or as that in the Kankakee section.

Corn, hay, and oats are still the principal crops, although in the northern part of the county trucking and dairying have replaced general farming to a considerable extent. The truck crops are heavily fertilized, and good yields are obtained. This soil is naturally of low productiveness, and under average farming methods it yields 20 to 30 bushels of corn or a little more of oats per acre.

For ordinary farming the selling value of this land ranges from $40 to $80 an acre. Where located near cities and used for trucking it commands several hundred dollars an acre, and for industrial uses the value is even higher.

This type needs heavy applications of manure and other fertilizer, and is best fitted to trucking where favorably located. In a system of general farming the growing of cowpeas for hay and as a soil-improving crop is advisable. The soil is acid and should be limed so as to be better adapted to legumes.

Some areas in Gary, Hammond, and East Chicago have been modified by cutting down the ridges and filling the sloughs. The resulting soil is mapped as Plainfield fine sand rather than Made land.

Plainfield fine sand, rolling phase.—In uncultivated areas the rolling phase of the Plainfield fine sand consists of 2 or 3 inches of brown to dark-brown loamy fine sand, overlying yellowish-brown loose fine sand. In plowed fields the dark surface color disappears, being displaced by grayish brown to brown.

This phase is mapped on the scattered "islands" of the Kankakee marsh, and is the characteristic soil of the three ancient beach lines crossing the northern end of the county. Small areas of Coloma fine sand are included, as on the county line northeast of Grahams.

This phase is distinguished from the typical Plainfield fine sand by its rougher topography. The surface is billowy or ridged, rising 10 to 50 feet above the adjoining black land. The boundary between this phase and the dunes is rather arbitrarily drawn.

The rainfall runs off this soil, or soaks in, almost immediately, so that it is very droughty. Probably over half of its total area still bears a scrubby growth of oak. In some places the growth is larger, doubtless owing to heavier strata which hold the moisture near the surface.

Only the smoother parts of the phase are farmed. The main crops are either corn, hay, and oats, or truck, such as cucumbers and tomatoes. All the available organic matter is incorporated in the soil, but yields are low even with the best of treatment.

For general farming this land is valued at $50 an acre, but its value for industrial sites and speculation is very high.

This soil is low in all the elements of plant food, and in addition is too droughty to be very productive. Its best agricultural use is for truck growing. It might be profitably used for cultivated blue berries or huckleberries, as wild varieties grow on it.

PLAINFIELD FINE SANDY LOAM.

The soil of the Plainfield fine sandy loam consists of a fine sandy loam to loamy fine sand, grayish brown in color to a depth of 8 or 10 inches and below this light yellowish brown. At about 24 inches

there is a relatively compact stratum of fine sandy loam to clay loam, and this in turn grades into loose, yellowish-brown sand at about 3 feet. The loose material also composes the substratum to some depth. The type may grade into the Plainfield fine sand on the one hand or into the Lucas fine sandy loam on the other. In some places the surface soil is darker than typical.

This type occurs in the vicinity of Hobart, in the Kankakee Basin, and along West Creek. The topography is level, or slightly uneven near stream ways. The soil is well drained, but it is less droughty than the fine sand type.

The Plainfield fine sandy loam is of relatively small extent in Lake County. It was originally forested with a good growth of oak and hickory, but most of it is now under cultivation, used mainly for mixed farming, which includes dairying and trucking. In most places it has been intensively cultivated and manured, so that it is more productive than formerly. Corn yields over 30 bushels per acre and other crops in proportion.

The selling value of land of this type is about $100 an acre.

The chief need of the Plainfield soils is more organic matter. This can be supplied by the manure produced on dairy or stock farms. Another plan is to lime the soil and grow clover, cowpeas, or rye and vetch for green manures. Cowpeas may be planted in rows, cultivated, and harvested for grain or hay.

A few very small areas of second-bottom soil (Fox fine sandy loam) along Deep River are classed with the Plainfield fine sandy loam in mapping, because of their small extent.

HOMER SILT LOAM.

The soil of the Homer silt loam consists of a light-gray to brownish-gray, rather compact silt loam extending to an average depth of 8 inches, where a light-gray to white silt loam subsurface layer is encountered. In places the surface soil is made darker by accumulations of organic matter. The subsoil, which begins at 12 to 16 inches, consists of a light-gray or drab, heavy, impervious, plastic clay, more or less mottled with yellow and brown. More yellow occurs in the subsoil in areas where this type adjoins the Lucas soils. The substratum consists of heavy, compact clay which is calcareous at a depth of 5 or 6 feet, at which level lime concretions are found. It is probable that sandy strata underlie this soil at depths of 20 to 40 feet.

The Homer silt loam is found only in the vicinity of Hobart. It has a flat surface, with a few slight irregularities. The type is not reached by natural drainage ways, but short ditches remove the rain water. The heavy clay subsoil greatly retards underdrainage.

This soil is of small extent in Lake County. It includes the western end of the extensive development of Homer silt loam in Porter

County. The native forest growth consists chiefly of red oak, black oak, pin oak, and elm, which have been largely removed.

A mixed type of agriculture is carried on. Corn, oats, and timothy are the chief crops grown, and all give fair to good yields. The chief needs of the type are tile drainage and the incorporation of larger amounts of organic matter.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Homer silt loam:

Mechanical analyses of Homer silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
282752	Soil	0.8	1.6	1.9	10.1	2.9	57.7	25.0
282753	Subsoil	.7	1.5	1.9	10.5	3.0	60.8	21.5
282754	Lower subsoil	.3	1.6	1.7	8.2	4.3	49.3	34.5

CALUMET FINE SAND.

The Calumet fine sand consists of a brownish loamy fine sand, 2 to 5 inches deep, passing into pale-yellowish or grayish-yellow, incoherent fine sand, which usually grades quickly into an almost colorless fine sand, extending to considerable depths. This subsoil material looks like fresh beach sand, as it consists principally of translucent quartz grains with a small admixture of brownish-colored grains and water-worn gravel. Some areas consist of medium-textured sand. Local patches may have considerable small gravel strewn over the surface and through the soil section. The very gravelly areas are indicated on the map by gravel symbols.

In some places the shallow surface layer, containing organic matter, has been removed by wind or water erosion, while in other places, as in depressions or along the line of contact with marshes, the loamy layer is considerably deeper.

This type is confined to the northern edge of Lake County, mainly to the north of the Grand Calumet River and west of Gary. It occurs in long, narrow ridges separated by narrow marshes. In many places the ridges have been cut down and the marshy lands filled in, making extensive level areas, which are used for building sites. The ridges parallel the present shores of Lake Michigan except where they curve around Lake George and Wolf Lake. From end to end of each strip the elevations are the same, but the cross section of a ridge shows the edges just above the water level of the adjoining marshes and the middle crest or crests 1 to 6 feet higher. Sometimes long, very narrow depressions run through the areas, but these are too small and shallow to produce marshy conditions.

The crests of the higher areas of this type are excessively drained, because of the porosity of the material, despite the fact that the water table stands within 3 feet of the surface over much of the type.

The Calumet fine sand is of low productiveness and its value depends entirely on its use for industrial purposes. A few areas here and there are devoted to vegetables. Only the older and higher ridges are forested, the growth consisting of scrubby oaks. Other areas have small poplar, scrubby pine, and bushes. Willows grow along the marshes.

WAUKESHA FINE SANDY LOAM.

The soil of the Waukesha fine sandy loam is a dark-brown, mellow, fine sandy loam, averaging 10 or 12 inches in depth. The subsoil is a brown or yellowish-brown fine sandy loam or loam, usually grading nto loose fine sand at about 30 inches. In the vicinity of the moraine some stones may be found on the surface.

Most of the areas of this soil are mapped along the northern border of the Kankakee Basin. Several occur at the southern edge of the Lake Chicago basin. The type generally adjoins the till deposits and occupies higher elevations than other near-by Waukesha types. The topography is level to undulating and the surface drains naturally to lower land. The underdrainage through the sandy material is apt to be excessive.

This type is all under cultivation, corn, hay, oats, and wheat being the most important crops. In average seasons the yields equal those obtained on the Waukesha loam, but they are apt to be lower in times of drought. Barnyard manure is used to maintain the productiveness.

The selling value of the Waukesha fine sandy loam ranges from $100 to $150 an acre.

WAUKESHA LOAM.

The Waukesha loam is a dark-brown loam or silt loam to a depth of 10 or 12 inches. The subsoil is a yellowish-brown loam to silt loam, grading into yellowish-brown sandy loam within 3 feet of the surface. The substratum consists of porous sandy and gravelly material. The boundaries are often indistinct between this soil and other Waukesha and Newton types. Some of the areas approaching most nearly a true loam occur in secs. 19 and 30, T. 33 N., R. 7 W.; secs. 24, 25, 26, and 27, T. 33 N., R. 8 W.; and sec. 1, T. 32 N., R. 9 W.

The Waukesha loam occurs along the lower border of the moraine and in the West Creek Valley. Its surface is level or sloping gently southward. Both surface run-off and downward drainage are thorough and the soil is slightly droughty.

This soil is of small extent, but most of it is improved. It is devoted largely to grain farming, although considerable live stock

is raised. Yields of 35 to 40 bushels of corn or oats and 1¼ tons of timothy hay per acre are usually obtained. Commercial fertilizers are used only in small applications. The soil is rather acid and would be benefited by liming. The use of acid phosphate would also improve the yield.

An average valuation of land of this type is estimated at $110 an acre.

NEWTON LOAMY FINE SAND.

To a depth of about 7 inches the Newton loamy fine sand is a brown to dark-brown, loose, loamy fine sand, grading below into a yellowish fine sand which is more or less mottled with gray and yellow.

This type is found in a few small areas in the Kankakee Basin, and more extensively in the northern part of the county, mainly between Tolleston and Glenwood Beaches. It occurs in positions lower than the adjoining Plainfield soils and higher than the Maumee soils. The topography is flat to slightly ridged or cut by channels, and natural drainage is fairly good. The type in its natural condition was seldom submerged, although the subsoil was frequently waterlogged.

This type has an important place in the agriculture of the county, despite its low natural productiveness. Because of its location near centers of population, its fair drainage, and its being so easily handled, great use is made of it for trucking. Originally it was prairie or only thinly forested, pin and blackjack oak being the principal trees. Corn is grown both as a field and truck crop and oats are grown to some extent. A few undeveloped areas yield only marsh hay. Cabbage, onions, sugar beets, tomatoes, melons, cucumbers, celery, and many other early truck crops are produced for both retail and wholesale trade. A large part of the cabbage, cucumbers, and tomatoes is handled by near-by kraut, pickling, and canning factories. Practically no stock feeding or dairying is carried on. The yields of crops depend upon the cultivation and fertilization. Manure is brought from neighboring towns and from the Chicago stock yards. Acid phosphate is the chief mineral fertilizer commonly used. Occasional damage by disease and insects and variations in the weather conditions have considerable influence on the yields of truck crops. Cabbage, for instance, ranges in yield from 6 to 16 tons per acre.

Where used only for the cutting of marsh hay, this land has a value of about $50 an acre, but areas in highly improved, well-located truck farms are worth as much as $500 an acre.

NEWTON FINE SANDY LOAM.

The Newton fine sandy loam consists of about 6 inches of dark-brown, mellow loamy fine sand to fine sandy loam, grading into light

grayish brown or yellowish-brown loamy fine sand to fine sandy loam, more or less mottled with gray and brown. The deep subsoil and the substratum usually consist of yellowish-brown, loose sand or fine gravel. Some areas in the northern part of the county overlie clay beds.

Areas of this type are found in the Kankakee Basin between Jerry Island and Schneider, and in the Lake Chicago plain between the Glenwood and Tolleston Beaches. A few small areas of rather mixed origin occur in the morainic belt south of Leroy.

The topography is flat, except for very slight rises and depressions. The type generally lies at elevations between the lower Maumee types and the higher Plainfield soils. Its natural drainage is imperfect, in spite of the porous substratum, because of its high water table, which, however, has been lowered by ditching.

In its natural condition the Newton fine sandy loam has the appearance of a desirable soil, but, in common with all other types of this series in Lake County, it is extremely acid. In the native prairie sod the grasses make an irregular, patchy growth, while on cultivated lands there may be a thick growth of dewberries, cinquefoil, red sorrel, and white violet. All crops make a poor, uneven stand.

Investigations of this class of soil by the Indiana Experiment Station [2] indicate that nitrates, with aluminum as the base, are formed. Even in very dilute solutions these salts inhibit the development of root hairs and roots, so that crops are starved and stunted. This condition may be corrected by liming.

Formerly this soil was used chiefly for pasture and wild-hay production, but it is now under cultivation. In the southern areas corn, oats, hay, and wheat are grown, and give a little lower yield than on the Maumee fine sandy loam. In the northern areas trucking is the main industry, and the productiveness has been built up by very heavy applications of manure and commercial fertilizers. Recent fertilizer demonstrations have converted farmers to the use of 300 to 600 pounds of acid phosphate per acre for cabbage and other truck.

While this type commands only ordinary prices where it is used for general farm crops, it is worth several hundred dollars an acre near Hammond.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Newton fine sandy loam:

Mechanical analyses of Newton fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
282763	Soil	0.2	7.8	18.2	45.7	3.4	12.7	11.7
282764	Subsoil	.1	4.7	16.0	56.2	2.2	11.8	8.8

[2] Bulletins 157 and 170, Indiana Agr. Expt. Sta.

NEWTON LOAM.

The surface soil of the Newton loam is a dark-brown, mellow loam to heavy fine sandy loam, ranging from 8 to 12 inches in depth. The subsoil, to a depth of about 30 inches, is a mottled yellowish-brown and gray loam, changing to a grayish sandy loam or gravelly sandy loam which extends to a depth of several feet. There are some spots where heavier strata occur in the subsoil. Like the Maumee loam, this type has been formed by the admixture of silts and clays washed from the uplands with sandy lake material.

The Newton loam occurs between the Waukesha and Maumee soils of the Kankakee plain, and also north of Hartsdale and around Hobart. It includes flat areas lying at elevations intermediate between those of the Waukesha and Maumee soils. The drainage is also of intermediate character, favorable to the accumulation of acidity in the soil.

Like the other types of this series, the Newton loam in the Kankakee Basin is devoted to general farming, and it gives fair yields, though the returns are lower than on the Maumee soils. In the northern areas trucking is more important than grain or dairy farming. Heavy applications of lime and the use of acid phosphate are the prime requisites of this as well as of the other Newton soils.

Results of mechanical analyses of samples of the soil and subsoil of the Newton loam follow:

Mechanical analyses of Newton loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
282730	Soil	2.0	6.0	7.4	19.4	7.5	40.2	17.5
282731	Subsoil	2.7	9.0	12.2	26.5	7.0	28.9	13.6

NEWTON SILT LOAM.

The Newton silt loam is a dark-brown silt loam underlain at 10 or 12 inches by grayish-brown or mottled yellow, gray, and brown silt loam to silty clay loam. At 2 to 3 feet a lighter-textured material is encountered, usually a mottled brown, yellow, and gray sandy or fine gravelly loam, which continues to some depth.

This type occurs south of Belshaw and Orchard Grove, and southeast of Dinwiddie. Two areas also are found south of Highland. The surface is level, except for slight irregularities, and the drainage was originally imperfect, though not so poor as that of the Maumee soils. Excess water is now removed by ditches.

This type is closely associated with Newton loam, and is simlar to it in most respects. It is put to the same agricultural uses, and gives about equal returns.

Newton silt loam, heavy-subsoil phase.—The Newton silt loam, heavy-subsoil phase, consists of a dark brownish gray, heavy silt loam extending to an average depth of 10 inches, underlain by a grayish-brown silty clay loam, slightly mottled with brown and gray, which grades at a depth of 12 to 16 inches into a mottled yellow, gray, and brown, plastic silty clay. The subsoil consists of lake-deposited clays. Both the lower subsoil and the substratum are usually calcareous.

This type is mapped between the Glenwood and Calumet Beaches. The areas mapped north of Munster along the Calumet River are of obscure origin and might be classed as a second-bottom soil,[3] composed of alluvial sediments, although the bowlders and stones indicate the presence of some glacial till.

The surface is flat, except for low rises and swales. The original drainage was not good, but the imperviousness of the subsoil has caused mottlings even where the surface drainage was fair. The type has been artificially drained.

This is a relatively inextensive soil, but it is known to be a strong, productive type, suitable for growing corn, oats, and hay. Although located in the truck district, it is too heavy to be generally favored for vegetables. Some of it is used to pasture dairy herds. Corn on this type withstood the early frost in 1917 better than on most other soils of the Lake Chicago Basin.

Average yields of 40 bushels of corn, 45 bushels of oats, or 1½ tons of timothy hay per acre are obtained without the use of much fertilizer.

The principal needs of this soil are more thorough drainage, the rotation of crops, to include legumes, and the use of acid phosphate.

MAUMEE LOAMY FINE SAND.

The Maumee loamy fine sand consists of a black or dark-gray loamy fine sand, ranging from 8 to 16 inches in depth, underlain by light-gray, loose, incoherent fine sand. The deeper areas may have a slightly heavier subsoil than typical. In places the subsoil is mottled with yellowish brown and rusty brown, somewhat like that of the Newton series. This soil typically represents a marshy prairie, but in places it is forested with pin oak, blackjack oak, or willow.

Areas of the Maumee loamy fine sand are found in the northern lake plain, chiefly around Griffith, and in the Kankakee Basin around Schneider and Shelby.

The type has a smooth, level surface. It was originally marshy and covered with water part of the year, and some areas are still in a marshy condition, especially those in the northern part of the county and those surrounded by sand hills and ridges.

[3] Representing the Warner series recognized in other surveys.

This is naturally the poorest soil of the Maumee series, and probably 75 per cent of it has no agricultural use beyond the production of marsh hay. In general farming sections this soil produces fair yields of corn, oats, and hay, or is used as pasture. In Lake County it is used most successfully in the truck district, under the usual methods of intensive cultivation and heavy fertilization. It is one of the best soils for cabbage, tomatoes, celery, cucumbers, melons, sugar beets, and similar crops.

For mixed farming the selling value of this land is about $80 an acre. Well-located areas suitable for growing truck are worth several hundred dollars an acre.

Phosphoric acid and lime should be used, in conjunction with manure, on land of this type. Better drainage is the greatest need.

MAUMEE FINE SANDY LOAM.

The soil of the Maumee fine sandy loam is a black, mellow fine sandy loam to loamy fine sand, ranging in depth from 12 to 20 inches. This is underlain by a dark-gray fine sandy loam, slightly mottled with yellow, grading within a few inches into light-gray fine sandy loam. In places the rusty-brown mottlings are present in the subsoil. The substratum usually consists of light-gray, loose sand, more or less mottled with yellow. The principal variations in this type consist of included areas having a slightly mucky surface layer, areas approaching a loamy fine sand in texture, and a large area near Munster which is underlain by a heavy clay substratum.

The Maumee fine sandy loam is found in large areas between Illinoi and Jerry Island, in the Kankakee section, and between Tolleston and Munster in the northern lake plain. It has the flat topography typical of the Maumee series. The type includes a large part of the Kankakee and Cady marsh lands, which have been transformed into good farm land by drainage operations within the last 15 to 25 years.

Practically all of this type is used for agriculture. In the southern basin corn, hay, and oats have displaced the marsh hay which was formerly the only crop produced. This soil has recently been found to be adapted to wheat, and includes much of the acreage devoted to that crop in Lake County. Yields of 30 or 40 bushels of wheat per acre are reported. This is practically a virgin soil, and corn and oats yield 35 to 70 bushels per acre. Part of the type is used for pasture, and cattle are turned into stalk and stubble fields in the fall.

In the northern basin a small part of this soil is used for mixed farming, but much of it is included in truck farms. In the latter case the productiveness is increased and maintained by the use of manure (from cities and stockyards) and phosphatic fertilizers. The price of potash at present (1917) is prohibitive, and experiments

generally show that phosphorus is the most beneficial element of plant food that can be applied.

Farms on this type suitable for grain farming are valued at about $110 an acre. Land suited for trucking may bring as much as $200 to $500 an acre.

Most of this type should be better drained, and fertilized with acid phosphate at the rate of about 150 pounds per acre for grains and 300 to 500 pounds for truck.

Maumee fine sandy loam, mucky phase.—As mapped in Lake County the mucky phase of the Maumee fine sandy loam is extremely variable in character and indistinct in its boundaries, but it typically consists of dark-gray to black fine sandy muck or mucky fine sand, 15 to 20 inches deep, passing into light-gray or gray fine sand to fine sandy loam, slightly mottled with brown.

The surface of this soil is quite flat, although it occurs on slight rises surrounded by other mucky soils, or as a transitional zone between muck and higher sandy soils. It formerly occupied the bed of permanent marshes, but has been fairly well drained by numerous dredged ditches. The porous, sandy understrata facilitate the drainage, but the water table still lies near enough to the surface to prevent the soil from being droughty, even where the subsoil lacks any heavy-textured layer.

This phase is mapped only in the Kankakee Basin, where it is relatively extensive and important. It has been only a few years since the cutting of marsh hay gave way to the growing of corn, oats, timothy, and wheat. Small grains tend to lodge, but average acreage yields of 40 bushels of corn, 45 bushels of oats, 25 bushels of wheat, and 1½ tons of hay are obtained. The quality of the grain is poorer and danger from frosts is greater than on the upland soils of the county.

The selling price of this land averages about $105 an acre.

No great use is made of fertilizers on this soil. It seems that phosphoric acid is needed more than potash. Applications of 200 pounds per acre of acid phosphate would balance the excess of nitrogen and insure higher yields and better quality of grain.

MAUMEE LOAM.

The Maumee loam consists of a black loam, about 10 inches deep, underlain by a dark-drab, heavy loam to clay loam, mottled with brown. This passes at about 20 inches into light-gray, plastic clay, more or less mottled with yellow and brown. Some areas are found in which the surface soil consists of fine sandy loam to a depth of 2 or 3 inches, and others in which the surface material is slightly mucky. In some patches the soil resembles the Newton loam, and in others it consists of a fine sandy clay loam. The sub-

stratum consists of water-laid sand and gravel interstratified with layers of heavier material.

The greater part of the Maumee loam is found in the Kankakee Basin just south of the outwash-plain soils and northeast of Dyer. In almost every case this type has clearly been the result of the deposition of silt and clay sediments by streams flowing out of till uplands, these finer sediments mixing with the prevailing sandy lacustrine material to form the varied loam soil.

This type has the very flat topography typical of all marsh land. It usually lies a little higher than the Muck soils and lower than the Newton and Waukesha types. Drainage is now well established in most places, and almost all of the type is arable.

Two decades ago marsh hay was the only product of this soil, but it is now of minor importance. The growing of corn, oats, hay, and wheat, combined with the feeding of cattle and hogs, is the main farm industry. The soil is strong and productive when properly drained. Average yields are ordinarily 40 bushels of corn, 45 bushels of oats, and 25 bushels of wheat per acre. Timothy yields about 1½ tons per acre. The soil is usually "sweet" and apparently does not require lime or fertilizers. All the available manure is spread on the fields. The average selling value of this land approximates $135 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Maumee loam:

Mechanical analyses of Maumee loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
282740	Soil	2.0	12.2	13.3	28.4	7.4	23.9	12.8
282741	Subsoil	2.7	10.6	13.6	30.8	10.7	21.8	9.4

MAUMEE SILTY CLAY LOAM.

The Maumee silty clay loam consists of a black silty clay loam grading at 8 to 12 inches into a dark-drab silty clay, slightly mottled with brown. This passes at about 20 inches into light-gray or drab, plastic clay, mottled slightly with rusty brown. Considerable variation occurs in the color because of included patches of bog iron ore or places where a mucky surface layer has burned out. Local textural differences range from mucky loam to silty clay. Most of the large area north of Dyer has a clay substratum, and in places this is moderately calcareous.

The Maumee silty clay loam is found in old glacial drainage channels throughout the morainic belt, and extending as far south as the

Singleton Ditch. A very large area lies north of Dyer and a few others are scattered in other parts of the Lake Chicago Basin. Although streams now flow through many of the areas, the soil does not consist of recent alluvium. The material was deposited in glacial times, when far greater currents flowed through the valleys.

The surface of this soil is flat except for slight irregularities and a gentle fall down the valleys. It was originally wet land, but the old streams have been straightened and outlets have been provided by the dredged-ditch system. Owing to the sandy substratum, ditches are usually effective.

Little of the Maumee silty clay loam is waste land. Corn, oats, and hay are the principal crops. Marsh hay was formerly the chief product, and it is still cut in a few fields. Timothy and clover are grown for hay, and cattle, usually of the beef type, are pastured and fed. Corn and oats both yield over 40 bushels per acre on an average. Timothy or mixed hay can be depended upon to yield about 1½ tons per acre. This soil is new and strong, and farmers have given little attention to fertilizing it or to maintaining its productiveness.

Most of this type is held for $100 to $150 an acre, but in the northern part of the county it has a higher value because of its location.

More thorough drainage is the principal need of this soil. Although the outlets are good, many fields would be benefited by tiling, so that the crops might be seeded early and be cultivated even in wet seasons. The rotation of crops, including legumes, and the use of some acid phosphate would tend to maintain the natural productiveness of the soil.

Some areas included with the Maumee silty clay loam, principally along the Little Calumet River west of Blackoak, really represent the Wabash silty clay loam. They consist of 12 inches of black silty clay loam, passing into dark-drab or brown silty clay, which in turn gives way to a lighter drab silty clay, mottled with faint brown. This soil occupies the lowest part of the bottoms and is subject to frequent overflow by the streams. It has not been used agriculturally except for the production of wild hay. A few "drowned-out" corn patches were observed in the course of the soil survey. This land is valuable because of its location. With good drainage, such as may be expected if the Burns Ditch is established, this can be made one of the best soils in the county.

GRIFFIN FINE SANDY LOAM.

The Griffin fine sandy loam consists of a dark-brown or chocolate-brown, mellow fine sandy loam, 8 to 12 inches deep, underlain by lighter brown fine sandy loam to loam which is more or less mottled with rusty brown and drab. In places the mottlings are very pro-

nounced, and some textural variations are found. The type is derived from recent alluvium, washed largely from glacial, but partly from lake soils.

This type is found in the valley of Deep River south of Hobart. The surface i flat and leve except for the general slope of the stream valley and local irregularities due to the presence of abandoned channels. The drainage is fair near the streams, but poorer near the uplands. In rainy seasons the type is subject to overflow.

This soil is inextensive, and only a small part of it is cultivated. There are a few small fields of corn on this soil, and a little wild hay is cut, but weeds are troublesome because of the seed carried by the streams. The best and at present the most important use of this type is for pasture. Part of it is still forested with maple, elm, sycamore, and other lowland trees.

The selling value of this land ranges from $50 to $150 an acre, according to the location and the nature of the adjoining land.

The wider valleys occupied by this soil should be drained and protected from overflow, after which they would make good truck or corn land.

WABASH SILT LOAM.

The Wabash silt loam consists of a dark-gray to black, friable silt loam, passing into dark-drab silty clay loam or silty clay which may be slightly mottled with brown in the lower depths. In some places the surface material is slightly mucky or sandy.

This type is mapped only in the bottoms of Calumet and Deep Rivers, near and east of their junction. It occupies comparatively well drained natural levees near the stream channels, and also some flatter, wetter situations farther back. It is subject to overflow.

This type is relatively inextensive and unimportant in Lake County. Little of it is cultivated. Corn and oats are grown in some places and seem to do well. Wild hay is cut from some areas.

The present value of the Wabash silt loam for agriculture is low, although it is situated in a region where all the land is rather high priced. With perfected drainage it would become a very productive soil.

MUCK.

Typical Muck consists of black, thoroughly decayed vegetable matter, 3 feet or more in depth. It is found in a great variety of forms, one of which is mapped as a separate phase. Minor variations exist, owing to surface admixtures of sand or clay or to the occurrence of brown, peaty, fibrous layers in the subsoil.

Muck is found in many of the larger depressions throughout the middle morainic belts of the county. A few areas occur along slopes where organic matter has accumulated in places made wet by seepage

from porous strata. The Muck, as mapped in the Kankakee Basin, is in many places shallow, but is rather arbitrarily separated from the surrounding shallow phase on account of greater average depth. Muck is also mapped in the vicinity of Wolf Lake and Lake George.

The type as mapped north of Tolleston Beach in long, narrow sloughs, shows great variation. Its composition ranges from sandy to peaty, and it varies in depth from 3 inches to 3 feet, all of these changes occurring in areas only 100 or 200 feet wide. These areas frequently support a growth of willow.

The ordinary growth of Muck consists of flags, cat-tails, and coarse marsh grasses. The areas in their natural state are flat, depressed, and very wet, but many of them have been artificially drained for farming. At present about 40 per cent of the Muck is not used for the production of crops, except perhaps marsh hay. The remainder is used for growing corn, oats, and hay, for pasture, or, in the truck district, for growing corn, potatoes, cabbage, onions, celery, and similar crops.

Hay and the cereals make a rank growth on this soil, and the grain is apt to be light and immature. Crops are sometimes damaged by early frosts. With potash and phosphoric acid fertilizers, corn and oats may yield 40 to 50 bushels and timothy hay 1 to 2 tons per acre. Vegetables give heavy yields without such large applications of manure as are used on sandy lands.

In some areas of Muck, which might be termed a heavy subsoil variation, the soil consists of 10 to 24 inches of black Muck, passing into dark-gray or drab heavy loam to clay loam, which changes to a lighter gray loam mottled with brown. The surface soil sometimes contains appreciable amounts of sand and silt, and the subsoil usually runs into a loose sand substratum. The surface is solid, not loose and springy as in the areas of true Muck. This variation of Muck is found only in the Kankakee Basin, where it lies in very flat areas which were formerly marshes or shallow lakes, but which are now fairly well drained by a system of great dredged ditches, aided by a few lines of tile. The "dike" near the Kankakee River has stopped floods from that stream, but heavy rains in the Eagle Creek basin sometimes cause Singleton Ditch to leave its banks. This heavy subsoil Muck is important in the Kankakee country, because it is productive and well adapted to corn, oats, hay, and wheat. Stock is pastured on grass and in stubble or stalk fields. Crop yields are high, averaging about 50 bushels of corn, 60 bushels of oats, and 30 bushels of wheat per acre. Fertilizers or manure are seldom used. The average estimated selling value of the land is about $130 an acre.

A large area of marsh land lying along the Little Calumet River south of Gary is mapped with Muck. It is quite similar to the heavy subsoil variation. It consists of a mucky or peaty soil of variable

depth, but often surprisingly shallow. The subsoil is a soft, marly material having the appearance of ashes. It may really be an ashy residue, as the area is covered with grasses 6 to 8 feet high, which are usually burned off in the fall. Near the Calumet channel this soil resembles the Wabash types.

Muck, shallow phase.—The shallow phase differs from the typical Muck in that the black organic surface soil rests on gray sands at depths of 12 to 24 inches. It occurs in close association with the typical Muck and is used in practically the same way. The two soils are about equally productive and valuable. If the areas of this phase are burned off the productiveness of the soil is greatly lowered, as the organic layer may be entirely removed, only the unfertile sand remaining.

PEAT.

Peat consists of a brownish, fibrous mass made up of partly decomposed remains of the roots and stems of aquatic plants. The peaty layer is usually 3 to 10 feet in depth. Peat is found principally along the Grand Calumet River, in the Beaverdam Marsh, and about 3 miles southeast of Crown Point. It occurs in old sloughs and lakes, in distinct depressions surrounded by high land. It was formerly covered with water and is now saturated to within a few inches of the surface, except where ditched. Most of the land can ultimately be drained except that along the Grand Calumet River, which is very little above the lake level.

Practically none of the Peat is cultivated. In some cases it is bordered by a cultivated strip of Muck, and as drainage and cultivation are extended the material takes on the black, nonfibrous appearance of Muck.

Peat is best adapted to growing corn, onions, cabbage, celery, and other truck crops. Both potash and phosphatic fertilizers are needed for good results.

SWAMP.

As mapped in Lake County, Swamp is a continuation of the same type occurring along the Kankakee River in Porter County. The areas east of Jerry Island might fairly be classed as a phase of Muck, as the soil is mainly a mucky mass of widely variable material derived from the limbs, roots, and trunks of trees rather than from grass and moss. The substratum is grayish sand. West of Jerry Island the Swamp is higher lying and sandier and more like a swampy variation of the Maumee soils. Nearer the stream banks the soil may have the characteristics of the Griffin soils.

All of the Swamp, except one large area north of Beech Ridge, is outside the "dike" and subject to overflow by the Kankakee River. It is forested, principally with water maple, ash, elm, and swamp oak,

supplemented by some birch near the stream channels. Rushes and cat-tails grow tall in a few open glades. The old river course, even supplemented by the dredged channels, is of too small capacity to carry off the water from the extensive ditch systems in the upper Kankakee Basin, but this condition can be relieved by dredging, which is now going on.

The cost of preparing this land for cultivation would make farming unprofitable in most cases. The type has long been a source of wood, which is cut and hauled out during the winter. A number of hunting and fishing camps are located on rises or swells in the Swamp areas.

DUNESAND.

Dunesand consists of rather pale yellowish fine sand extending to great depths. The surface inch or two may contain a little organic matter. There is a large percentage of white quartz particles. The soil contains some medium sand, fine gravel, and small stones, such as are found on the lake beach.

Dunesand is confined to a belt along Lake Michigan, about three-fourth mile wide, which formerly extended from the Porter County line as far west as the center of Gary. In the Gary industrial district much of the type has been or is being leveled for building sites. The boundary as drawn on the map between Dunesand and the rolling phase of the Plainfield fine sand is rather arbitrary, but the Dunesand is younger geologically and has been more eroded by the wind than has the Plainfield soil.

The Dunesand occupies the roughest areas in the county. The hills are often very steep along one side, with more gradual slopes on the other. Blow-outs are found near the beach, where the wind sweeps up the sand through long, smooth troughs in the hills, forming bare peaks which are gradually fixed by the growth of grass and trees.

This soil is naturally very droughty, though it holds more moisture and supports a more thrifty vegetation than might be expected. Practically all of it is covered with scrubby oak, some pine, and an undergrowth of vines, bushes, and grasses. None of the type is cultivated. That part around the lagoon at Miller Beach is to be used as a park. The dunes are utilized as a source of sand, which is used for filling depressions and building up elevated-railroad tracks.

SUMMARY.

Lake County, Ind., is a roughly rectangular area of about 492 square miles, situated at the northwestern corner of the State, near Chicago. It includes three main physiographic divisions: (1) The plain of glacial Lake Chicago, (2) the Valparaiso morainic system and associated till plains, and (3) the outwash plain and lake plain of the Kankakee Basin.

The Lake Chicago plain occupies the northern end of the county and rises to the till upland through three topographic steps marked by old glacial-lake beaches known as the Tolleston, Calumet, and Glenwood Beaches. A rough strip of Dunesand lies along the beach east of Gary. The soil deposits on the lowest terrace give rise to the sandy members of the Calumet series, those on the middle terrace to the Newton, Plainfield, and Wabash soils, and the heavy deposits on the highest beach to the Lucas, Homer, and Maumee soils.

The morainic belt is 14 to 18 miles wide. It comprises three east and west ridges, with intervening level country, cut by north and south glacial drainage channels, along which the topography is rough.

The Kankakee Basin includes an outwash apron sloping south, and a marsh sloping gently westward.

The north half of Lake County is drained by the Calumet River into Lake Michigan and the south half by the Kankakee River, which is tributary to the Mississippi.

Lake Michigan is 585 feet above sea level. The moraines have an elevation of 665 to 800 feet, and the Kankakee Basin an elevation of about 630 feet.

Lake County was first settled between 1830 and 1840. The population now numbers over 100,000, but about one-third of the inhabitants are of foreign birth. The population is largely concentrated in the industrial district north of the Calumet River.

Gary, Hammond, and East Chicago are the largest cities. Crown Point is the county seat. Lake County is served by at least 14 railway systems, whose lines converge toward Chicago. The county is well supplied with telephone lines and good roads and schools.

The climate is variable and marked by considerable extremes of temperature. The mean annual temperature is 51°, the mean annual rainfall 31 inches, and the growing season 171 days in length.

Agricultural progress in this county was slow at first, but with the growth of Chicago and other industrial centers the steady demand for all kinds of agricultural products resulted in the development of well-defined farming belts. In the last 20 years there has been a great growth in dairying and live-stock farming. A large percentage of the county is now improved, and farm values have risen to a high level. The leading farm products, named in the order of their value, are cereals, hay and forage, beef cattle, dairy products, vegetables, and poultry. Corn, hay, and oats are by far the dominant crops.

A mixed type of farming is commonly followed. Trucking is a specialized industry in a small section. Grain and hay are produced partly for sale and in part for feeding dairy cows or for fattening

stock. The Holstein is the predominant breed of dairy cattle. Only whole milk is sold in quantities.

Twenty-nine soil types are mapped in Lake County, including Muck, Peat, Swamp, and Dunesand. The soils represent 13 series.

The Miami series includes light-colored, forested soils of glacial origin, with heavy subsoils. These are desirable farming types, responding to applications of nitrogen and phosphoric acid.

The Carrington series comprises dark-colored, well-drained, glacial soils occupying prairie areas. The silt loam and its mottled-subsoil phase are among the best and most important types in the county.

The Brookston silt loam is like the Carrington silt loam except for its poorer drainage. It is, however, a good agricultural soil.

The Clyde series includes the wettest and darkest of the glacial soils. When drained they make first-class farm land.

The Waukesha series comprises prairie soils of outwash origin, which are relatively droughty because of a porous subsoil. They are, however, fairly productive soils.

The Newton soils resemble the Waukesha in some respects, but are more poorly drained and generally acid. When limed they are quite productive. The sandy types are used for trucking.

The Maumee series includes marshland areas with deep black soils and grayish subsoils. They are now generally well drained and are very productive. The Maumee soils are in general well suited to growing cereals and hay, and the lighter members are used for trucking.

The Plainfield soils are forested, light-colored, lacustrine types with droughty subsoils. They constitute relatively poor farm land.

The Calumet soils are poorly drained and of recent origin, but otherwise they resemble the Plainfield soils. The fine sand type occurs almost altogether in the industrial district along Lake Michigan, and it is not used for agricultural purposes.

The Lucas soils resemble the Miami, but are of lacustrine origin. These soils are not droughty, and are desirable farming types.

The silt loam is the only member of the Homer series in this county. It is of lacustrine origin, with a light-colored surface soil and a very light gray and mottled, heavy subsoil. It represents good farming land.

The alluvial soils include the Griffin fine sandy loam, which is a brown soil, and the Wabash silt loam, which is a black soil. These types are in a comparatively undeveloped condition.

Muck typically consists of black vegetable matter 3 feet deep, but it occurs in a variety of forms. Several variations are recognized, among them shallow Muck over a heavy subsoil and Muck over marl, but only a shallow phase is separately mapped. Much of the Muck

is still too wet, but the drained areas are well suited for grains and truck crops.

Peat consists of brown, fibrous vegetable matter, as yet undrained and unfarmed.

Swamp includes forested areas of mucky soil and a soil resembling the Maumee series, but it is confined to low, wet areas subject to overflow by the Kankakee River.

Dunesand consists of areas of sandhills blown up along the Lake Michigan beach.

[PUBLIC RESOLUTION—No. 9.]

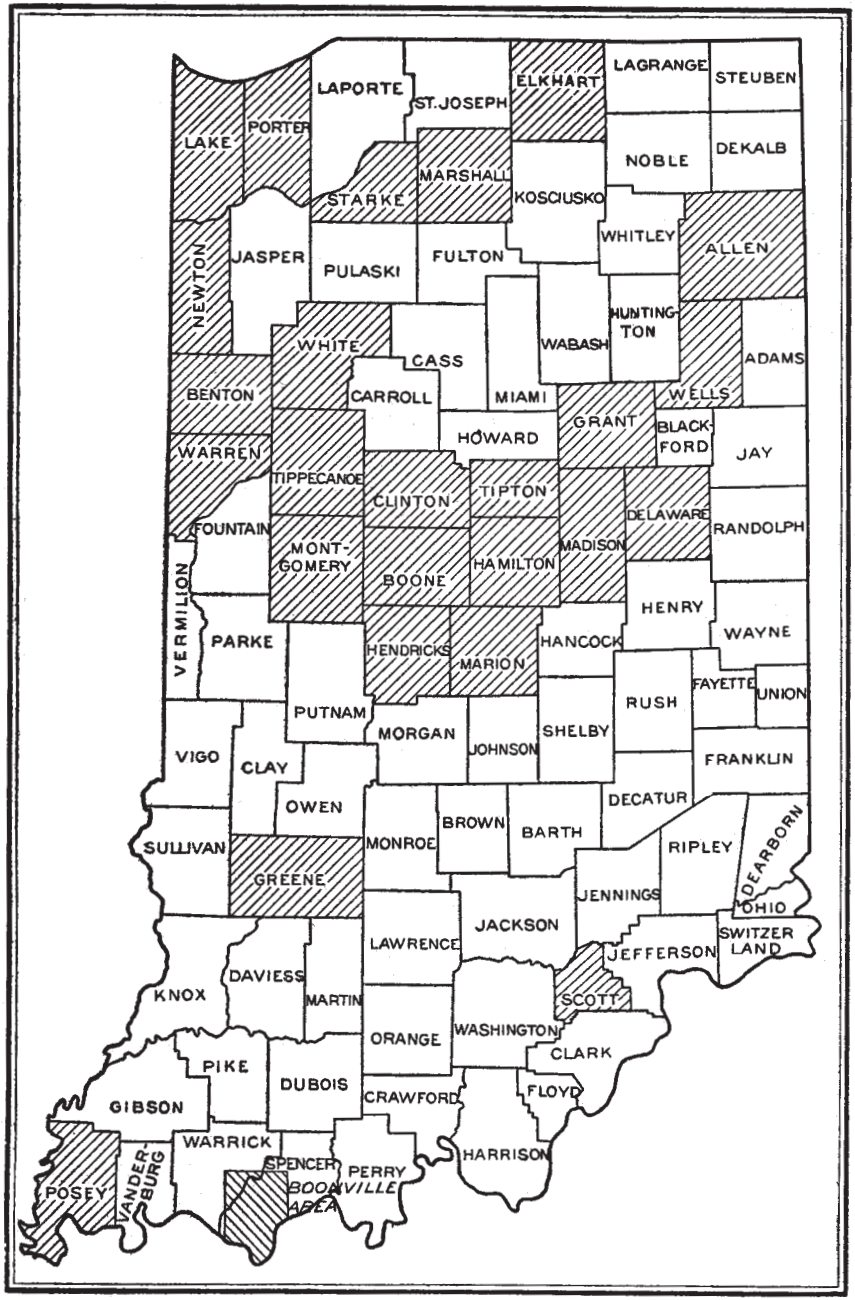
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Indiana.

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BUREAU OF SOILS
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CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
INDIANA
LAKE COUNTY SHEET

STATE OF INDIANA
DEPARTMENT OF GEOLOGY
EDWARD BARRETT, STATE GEOLOGIST

W. E. Mc Lendon, Inspector Northern Division
Soils surveyed by T. M. Bushnell of the U. S. Department of Agriculture in charge, and Wendell Barrett of the Indiana Department of Geology

Scale 1 inch = 1 mile

Field Operations
Bureau of Soils
1917